EFFECT OF CIRCUIT TRAINING ON CENTRAL FATIGUE, PHYSICAL PERFORMANCE AND COGNITIVE FUNCTION AMONG DIFFERENT LEVEL OF RECREATIONAL ATHLETES

SHORT SYNOPSIS

Submitted in partial fulfillment of the requirement of the degree of

DOCTOR OF PHILOSOPHY

to

Manav Rachna International Institute of Research and Studies

(Deemed to be University)

by

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Batch-2019

Certificate

I hereby declare that the short synopsis "Effect of Circuit Training on Central Fatigue, Physical Performance and Cognitive Function among Different Level of Recreational Athletes" being submitted in partial fulfillment of the requirement for the degree of Doctor of Philosophy in Physiotherapy under Faculty of Allied Health Sciences of Manav Rachna International Institute of Research & Studies, Faridabad during the academic year 2021-22. It is a bona fide record of original work carried out under the supervision of Prof. (Dr.) Moattar Raza Rizvi and has not been submitted in full or part to any other university or institute for degree or diploma. Further, it is certified that short synopsis is plagiarism free and proof has been submitted.

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ABSTRACT:

Background/Introduction: Central fatigue is often believed as a physiological event that plays an applicable role in muscle fatigue, helps in protecting muscles against imprudent effort. Various authors have given different definitions for fatigue. Fatigue is an exercise-induced decrease in maximal voluntary force or power produced by a muscle or muscle group. There is a decrease in performance of the central nervous system, in which training and mental tiredness is encountered.

Objectives: This study aims to measure the effect of circuit training on central fatigue, physical performance and cognitive function in different level of recreational athletes.

Methodology: It will be an experimental Study design (pretest-posttest) with three experimental groups. Total of 63 subjects will be selected as per inclusion and exclusion criteria and categorized into one of three groups (n=21) on the basis of Global Physical Activity Questionnaire i.e low, moderate and severe physically active recreational athlete. They will be given six weeks (3 days per week) of high intensity circuit training. Circuit training session will be comprised of warm up followed by six stations of circuit training and cool down. Pre test and post test outcome measures will be taken before and after the six weeks of circuit training respectively.

Expected outcome: We expect the circuit training to be an effective training for low physically active recreational athlete in reducing central fatigue, enhancing physical performance and cognitive function when compared with moderate or severe physically active recreational athlete.

Key words: Central Fatigue, Circuit Training, Muscular fitness, Balance, Proprioception

INTRODUCTION

- Fatigue is defined as exercise induced downturn in performance of athletes. It may also be defined as an exercise induced depletion in ability to strive muscle force. It may result due to changes at the level of muscular system which is called peripheral fatigue and due to the non fulfillment of central nervous system to sufficiently propel the motor neurons which is called central fatigue. (Freitas, T. T., Calleja-González,2016)
- Among the two divisions of fatigue i.e central and peripheral fatigue, central fatigue leads to composite exhaustion. It is imperative to study the mechanism of fatigue as there is an implication of central fatigue in chronic fatigue syndrome pathology and guides to decline in performance of mental task, disturbance of social life, ruination of brain functions from childhood to adulthood. The mechanism of central fatigue can be understood by neurochemical mechanisms which involves "tryptophan". Through tryptophan-serotonin enhancement hypothesis, central fatigue emerges from enlarged hallway. (Yamashita M, 2020)
- Central fatigue is often believed as a physiological event that plays an applicable role in muscle fatigue, helps in protecting muscles against imprudent effort. (According to Bigland-Ritchie et al. in 1983 and Gandenia in 2001).
- Every recreational athlete encounters fatigue in day-to-day life (Bart R,2010) Averting fatigue is an area of discussion nowadays for recreational athletes too along with professional athletes. This concern needs comprehension about the fatigue's understanding, its etiology and mechanisms (Mostafa K,2014)
- Various authors have given different definitions for fatigue. "Fatigue is an exercise-induced decrease in maximal voluntary force or power produced by a muscle or muscle group".
- As exercise proceeds the fatigue level increases and as the exercise stops the fatigue recovers (Janet L.T, 2008). The origin of muscle fatigue can be central and peripheral. Peripheral fatigue includes metabolic and biochemical changes within the muscle resulting in loss of force-generating capacities at or distal to neuromuscular junction.
- Central fatigue stipulates decrease in voluntary activation during exercise. The type, duration and intensity of exercise are several factors which are responsible for the magnitude of peripheral and central fatigue (Gonzalo M, 2016). Both causes i.e.

peripheral and central origin are involved. Hence, fatigue is considered as a compound phenomenon in which various factors are involved (R Meeusen, 2010).

- There is a decrease in performance of the central nervous system, in which training and mental tiredness is encountered. Central fatigue can occur alone i.e. without physical fatigue in those individuals who are engaged in occupations which are cognitive demanding. There is decline in the performance due to lack of sleep in the performance which is a common indicator of central fatigue (Graham P.B, 2008)
- Submaximal muscle contractions can also conduct central fatigue like maximal efforts. Subjects reach the task failure position and they are unable to produce the required force with sustained voluntary contraction of maximal force of more than 15-20%. Moderate exercise leads to increase in the core temperature which ultimately causes core temperature which ultimately causes rise in the nerve transmission speed. Hence, it results in speed up of simple reaction time. It also helps in increase of arousal level (Tomporowski & ellis,1986). Therefore, this beneficial effect of moderate exercise can explain the improvement on cognitive functioning of recreational athletes. It eases the performance in visual-detection of peripheral threshold (Daney,1972 &Allard et al. 1989) (McMorris, T., & Keen, P. (1994)
- GPAQ (The Global Activity Physical Activity Questionnaire). The physical activity participation of the population in three domains such as activity at work, travel to and from places and recreational activities can be monitored using a standardized protocol called GPAQ (developed by WHO). Physical activities intensity can be expressed in the form of metabolic equivalent (MET). MET can be defined as the amount of energy engrossed while sitting at rest and is analogous to a caloric expenditure of 1 kcal/kg/hour. According to WHO guidelines, MET values were assigned for moderate activities in work, recreation and travel (4 METs) and for vigorous activities (8 METs). Moderate activities includes those activities which requires moderate physical effort and causes small increase in heart rate or breath rate carrying light load is an example of moderate activity. Vigorous –activities includes those activities which requires hard physical effort and causes large increase in heart rate or breath rate. Aerobic, dancing, running etc are examples of vigorous activities. (Bharti Veer,D., Ghanekar, 2018).

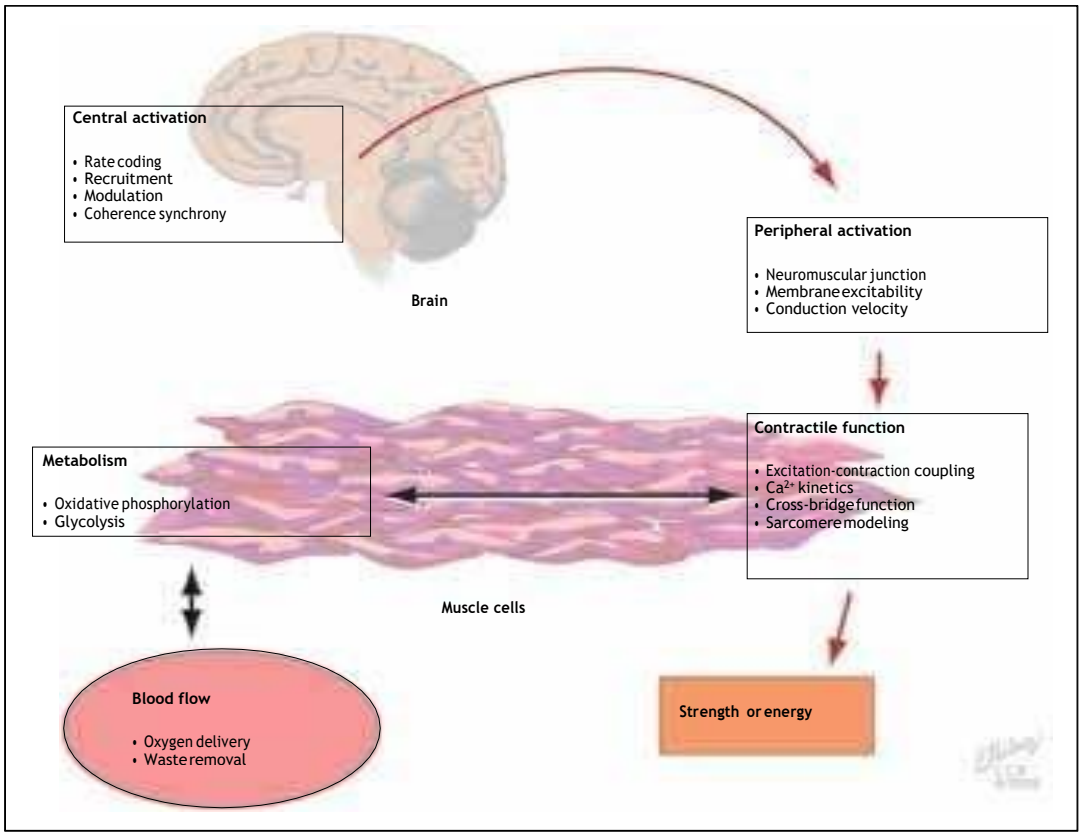

FIGURE 1 MECHANISM CORELATED ALONG MUSCLE ACTIVATION (Taken from Davis & Walsh, 2010**)**

MECHANISM OF FATIGUE ASSOCIATED WITH CNS ABNORMALITIES (Taken from Davis & Walsh, 2010)

- To engage muscle, fragility from motor cortex negligence occurs
- Deficient synergism like discharging of motor unit
- Retard deportation along with zestful service disablement
- Interchange in synergistic muscle offering to net force
- Deprivation of coherence between non-identical central motor neurons or dissimilar motor neurons within cerebral cortex and spinal motor neurons
- Swap in connective tissue and joint mobility from spasticity

- Muscle atrophy due to mislaying of innervations
- Disuse muscle atrophy subordinate to indolence
- Declined muscle oxidative phosphorylation due to atrophy

MECHANISM OF CENTRAL FATIGUE

- Deprivation of recruitment of excessive threshold motor units
- Decreased central drive from enlarged interdictory interneuron input to motor cortex
- Central conduction block from demyelization or motor neuron discontinued
- Enlarged negative feedback from muscle afferent types III and IV sensory neurons
- Dropping of positive feedback from muscle spindle type I sensory afferents

Circuit training is a type of training evolved by Morgan and Anderson in 1953. This training involves “a circuit” including 9-12 exercises (aerobic exercises, resistance exercise etc) at nine moderate pace. It includes several circuits with short breaks between them. This protocol involves different alternative exercises so that the muscle groups can recover from exercises. (Novotna, K., Sucha, L.,2019)

Cognitive exertion has a negative influence on the physical performance of the individuals.(Macmahon, C., Hawkins, Z., & Schücker, L. (2019)

Statement of Problem:

- It has been seen that fatigue is an important component of physical activity not only in sports but also in activities of daily living which can affect performance of both.
- There is a dearth of study indicating the role of central fatigue on Physical performance and cognition, so the purpose of the study is to evaluate the effect of central fatigue on Physical performance, cognitive and executive function in recreational athletes. The previous study has established the effect of high-intensity circuit training but there is lack of evidence showing its effect on low, moderate and vigorous physically active recreational athletes.
- The aim of the present study is to find out the effect of circuit training on central fatigue, physical performance and cognitive function among different level of Recreational Athletes

Objectives of the study:

- To measure the effect of circuit training on central fatigue in different level of recreational athletes.
- To measure the effect of circuit training on physical performance in different level of recreational athletes.
- To measure the effect of circuit training on cognitive function in different level of recreational athletes

Research Hypothesis:

- There will be a statistically significant effect of circuit training on central fatigue in different levels of recreational athletes.
- There will be a statistically significant effect of circuit training on physical performance in different levels of recreational athletes.

- There will be a statistically significant effect of circuit training on cognitive function in different levels of recreational athletes.

Null Hypothesis:

- There will be no statistically significant effect of circuit training on central fatigue in different level of recreational athletes.
- There will be no statistically significant effect of circuit training on physical performance in different level of recreational athletes.
- There will be no statistically significant effect of circuit training on cognitive function in different level of recreational athletes.

Operational Definitions:

- Fatigue: Fatigue is a "progressive loss of the ability to
- Central fatigue: Central fatigue consists of impaired muscle performance but arises from the central nervous system (CNS). During single or multiple supramaximal electrical stimulation, the central fatigue is adding the force to the muscle. generate maximum force during (or following) repeated or sustained muscle contractions or the loss of force generation during a task".
- **Recreational athlete**: A recreational athlete can be defined as "a person who is physically active but who does not train for competition at the same level of intensity and focus as a competitive athlete".
- **GPAQ: "**The Global Physical Activity Questionnaire was developed by WHO for Physical activity surveillance in countries. It collects information on physical Activity participation in three settings (or domains) and sedentary behavior. These domains are activity at work; travel to and from places and recreational activities"
- **Cognition:** "The states and processes involved in knowing which in their completeness include perception and judgment".

The origin of central fatigue occurs in the cerebral cortex. It can also evolve in the spinal cord (Mellar P.D, 2010). The central fatigue is influenced by excitatory factors which integrate sensory and motor signal transmission (Mustafa K, 2014). Certain Points regarding the mechanism of central fatigue are as follows:

a) There is a dearth of recalling of high threshold motor units (Mustafa K, 2014).

b) There is decreased excitation of the central drive from the enlarged input of the inhibitory interneuron to the motor cortex (Mellar P.D, 2010)

c) There is an occlusion in conduction of central guidance from motor nerve dysfunction (Mellar P.D, 2010)

d) The negative feedback from afferent Type 3 and Type 4 sensory neurons is Expanded/ Enlarged (Mellar P.D, 2010)

e) The deficiency of positive feedback from Type I sensory afferents of muscle spindle (Mustafa K, 2014).

f) The neural mission of the brain is influenced by training and the congregation of the neurotransmitter is increased with the help of training. The interchange in the brain neurotransmitters specifically serotonin or 5-HT are associated with central fatigue while the role of dopamine and noradrenaline are associated with interchange in the performance

g) According to the researchers, the concentration of 5-HT within the brain is increased and there is a decrease in dopamine causing fatigue. Therefore, because of the complexity of the function of the brain were explained by various research studies, not only one neurotransmitter is responsible for fatigue, but there is the change in the serotonin, catecholamine's, amino acid neurotransmitters and acetylcholine are the possible mediators in causing central fatigue during exercise.

h) Motivation, stress, arousal can be influenced by these neurotransmitters and they can disturb performance as well. (Mustafa K, 2014).

Relationship of temperature and Central Fatigue

Fatigue is a protective mechanism, averts homeostasis disruption, put the brain at risk which is efficient of increased temperature, according to the researchers, performance is reduced by central nervous system during maximal voluntary contraction under increased body temperature. Hence, high body temperature may influence performance during exercises under enlarged thermal pressure, temperature. (Kay D, 2000)

Dopamine and nor adrenaline hypothalamic area plays a vital role in thermal regulation. There can be a transfer in neurotransmitter concentration which further contributes to exchange or interchange during thermal regulation and solely for the sake of tiredness, specially once exercises take place within heated ambient condition. (R. Museen, 2010)

Relationship of hydration and Central Fatigue

Rate of perspiration depends upon climatic conditions, exercise intensity and clothing. Water loss of 1-2% & 3-4% of the body weight may reduce the physical work capacity by 6-7% & 22% respectively.

It has been observed that dehydration affects the cognition, impaired concentration, reasoning and mood (Masento, N. A. 2014)

- Gonzalo marquez, et al. (2016) has found reduced maximal voluntary contraction and resting potentiated twitch amplitude after High Intensity Resistance Circuit Training (HIRCT) in trained young subjects. While they found no significant difference in the above outcome measures after traditional strength training (TST). So, they concluded after HIRCT, and there is evident peripheral fatigue with the higher lactate concentration.
- Kimiya Sardi, et al (2014) conducted a study showing the effect of resistance and endurance exercises on central fatigue, and they focused on the mechanism and potential role of central fatigue. They stated that initially with the exercise, peripheral fatigue occurs and the CNS tries to prevent the disorder via output force through the perceptions of metabolic conditions of the muscle. They also found that the resistance and endurance exercises have a different mechanism of fatigue, but both types of exercise develop central fatigue.

- Janet C. Taylor et al. (2007) conducted a comparison between sub-maximal and maximal voluntary contraction on central aspects of fatigue. They stated that both the central as well as peripheral fatigue develop more slowly in the sub-maximal exercise. But central fatigue occurs maximum in sustained sub-maximal contractions. The study concluded that there should be exchange in motor unit discharge and force output to see sub-maximal contractions in central fatigue.

METHODOLOGY

Study design:

Experimental Study design (pretest-posttest) with three experimental groups.

Study Place: OPD, Department of Physiotherapy, Manav Rachna International Institute of Research and Studies

Outcome Measures

Physical performance

- Muscular Fitness Test
- Proprioception angle will be measured by Reposition error test (RET)
- Dynamic balance will be measured by Star excursion balance test (SEBT)
- Fatigue will be measured by Rate of perceived excursion (RPE)
- Static balance will be measured by Stork Test
- Power will be measured by Vertical high jump

Cognition:

- Stroop test

Central Fatigue:

- Beep test

Inclusion criteria:

1. Young adult 18 to 30 age group
2. Only males will be included in the study
3. BMI 18.9 to 24.9
4. Recreational athlete
5. Athletes who perform recreational activities for at least 1 year

Exclusion criteria:

1. History or presence of respiratory or cardiac disorder
2. Any musculoskeletal disorder
3. Any neurological disorder
4. History or presence of any recent injury
5. History of any surgery during past 6 months

Dependent Variable

- Circuit training

Independent Variable

- Central fatigue
- Physical Performance
- Cognitive function

Sample size: The number of subjects was determined using software G. Power version 3.1.92 using data of changes in counter movement jump height after acute response of circuit training as described in the study done by Freitas et al., 2016. We expect to have at least a similar change in

the outcome measures after 6 weeks of circuit training. Hence 63 subjects (21 subjects in each group) including 20% of drop out was shown to be necessary based on the effect size 0.927, alpha level of 0.05 & power (1-beta) of 0.95.

Instrumentation:

- Meter tape
- Marker/Chalk
- Audio tape of beep test
- SEBT chart
- Weighing machine
- Goniometer

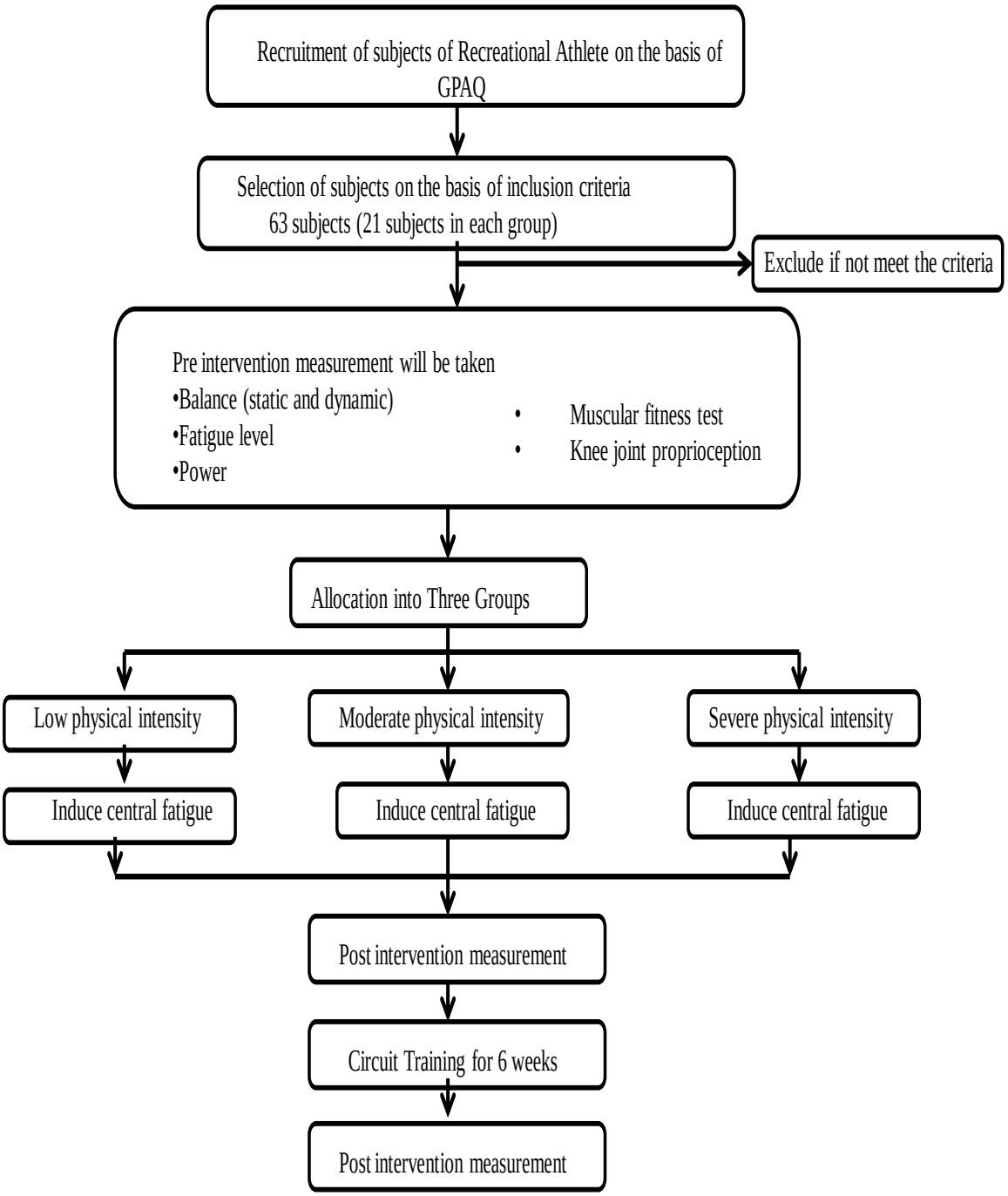
Recruitment of subjects of Recreational Athlete on the basis of GPAQ
Selection of subjects on the basis of inclusion criteria
63 subjects (21 subjects in each group)
Exclude if not meet the criteria
Pre intervention measurement will be taken
•Balance (static and dynamic)
•Fatigue level
•Power
• Muscular fitness test
• Knee joint proprioception
Allocation into Three Groups
Low physical intensity
Moderate physical intensity
Severe physical intensity
Induce central fatigue
Induce central fatigue
Induce central fatigue
Post intervention measurement
Circuit Training for 6 weeks
Post intervention measurement

Fig 2: Flowchart of study design

- **Procedure:**

- Each subject will be described regarding research and consent will be taken before including them into the study. Before starting the procedure, warm up exercises will be done by the subjects. A pre-test measurement which includes balance (static and dynamic), muscular fitness test, fatigue, power, cognitive function and knee joint proprioception will be measured before inducing central fatigue thereafter, Post-test measurements of the same will be taken.

- **INTERVENTION**: Six weeks of High intensity circuit training will be given to the subjects. Circuit training will be performed 3 days a week. Each session of training includes warm up exercises followed by circuit training and cool down exercises. Warm up exercises includes jogging, general body stretching. Circuit training includes six different stations: treadmill running, lateral pull down, weighted squat, shoulder raise, leg press and abdominal crunches. Cool down exercises include stretching exercises. (4-6 Familiarization session w.r.t circuit training will be given to the subjects to understand the protocol). Details of circuit training are explained in figure 3.

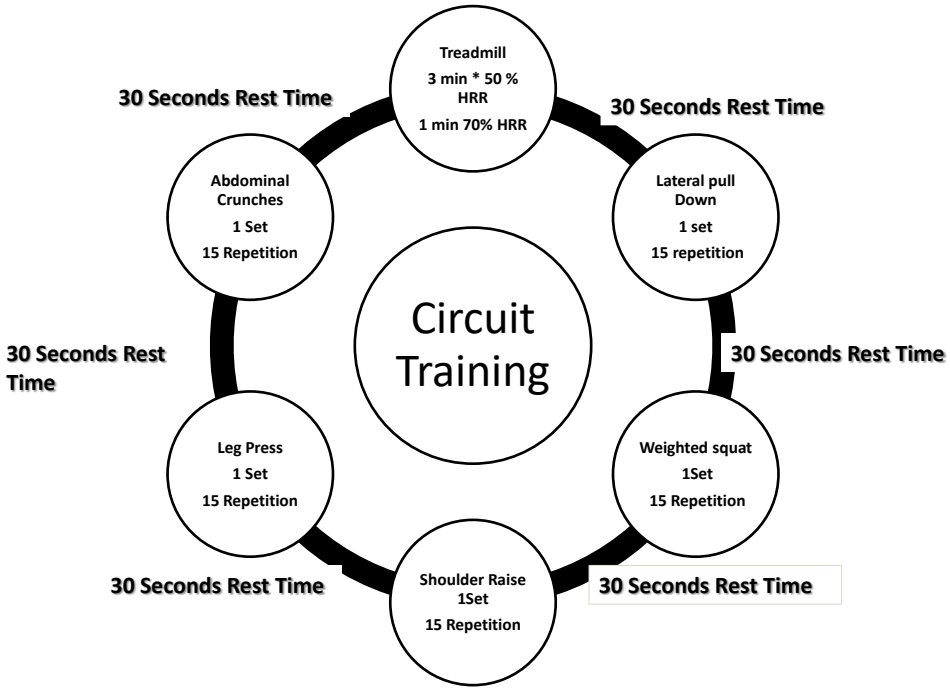

Fig 3: Schematic diagram of circuit training

- After 6 weeks of High intensity circuit training outcome measurements will be taken as similar to pre test measures.

Procedure of inducing central fatigue by maximal running

(Beep Test)

- Central fatigue will be induced by administering beep test, as it has been considered as a most reliable method.
- It is a multistage fitness test which includes running between 20 m distance using maximal aerobic fitness, and commonly known as 20-meter shuttle test or bleep test
- A brief explanation about the procedure is as follows:
- **Procedure:**
- The subjects will be asked to continuously run between two cones kept 20 m apart in recorded time after every beep. The subjects will be asked to stand behind the cone facing the second and start running when hearing the beep sound. Initially the speed of the intermittent beep is slow. The subject will be asked to maintain running between two cones, and try to reach the cone before the next beep. As the test progresses the duration between each beep is reduced and as a result the subject has to increase the running speed. If the person reaches the cone before the beep he has to wait until hearing the next beep. The duration between every beep is reduced every minute. If the subject fails to reach the cone for three consecutive beeps it will be considered the end of the test and the level of the beep will be noted for further calculation. In such case it is considered that the subject is fatigued.

- Flat surface
- Cones

- Measuring tape
- Beep test audio and audio player
- Recording sheets

Muscle Fitness Test

- The **muscle fitness test** consists of four parameter which includes: sit ups (hip flexion extension movement), pushups, deep squats and burpees. All exercises will be done for 60 second with a micro break of 10 seconds
- Sits ups: Strength and resistance for abdominal musculature is been tested with sit ups. The subjects will be asked to lie in supine lying position keeping both legs together and knees and elbow extended position, in the second position the subject will be seated performing trunk flexion, knee flexion and arm bracing the knee.
- Pushups: The strength of the upper limb will be measured by conducting push-ups before starting the test the subject will be asked to extend the elbow and palm of the resting hand on the floor at the chest level, keeping the trunk thigh and legs in aligned position before starting the exercise. While performing the exercises, elbow angle must be kept at 90 degree between arm and forearm.
- Deep Squats test: to evaluate the strength of the knee and hip extensors, the test will be executed by making the patient in standing position stand keeping the arms extended and maintaining same position throughout the test. Subject will be asked to bend the knees and hip proportionally until reaching angle less than 90 degree at knee without pause returning to the starting position.
- Burpees: For evaluating the strength of back, chest, arm and legs. Subject will be asked to stand keeping hand aside and palm facing forward. The subject will descend to squatting position with palm resting of the floor continuing to standing with back and knee extended and arm raised parallel to shoulder and elbow extended and cycle follows.

Assessment of Dynamic Balance:

- The assessment of Dynamic Balance will be done by Star Excursion Balance test (SEBT). To familiarize the subjects with the test, 6 trial runs will be conducted with a verbal and visual demonstration. To start with the test, a rest period of 2 minute will be given after the trail run.
- To start with the test, the subject will be asked to stand on a single leg at the center of the "star" keeping both hands on the pelvis. Extending the free leg in a particular direction to its maximum reach. Distance will be marked and measurement of the same will be recorded. Subject who fails to maintain their balance during the test a repeat test will be done for the same.
- The test will be performed in all 8 directions. Subjects will be asked to repeat the test at least 3 times in respective directions where best of 3 reading will be considered as the final reading.
- **Under three conditions the test will not be considered**
- 1.In case stance foot is lifted from the center of Grid during the reach
- 2. In case the subject loses balance
- 3. In case the subject fails to touch the line with the reach foot , keeping full weight on the stance foot.
- Before calculating the Balance deficit standardization of the leg length will be done
- "Measurement of leg length:
- Corrected leg length= (reach distance/leg length) *100"

Assessment of Knee Joint proprioception

- For calculating the knee proprioception error, angle reposition error methods using a goniometer will be included.
- A goniometer will be placed to distal part of the thigh just one inch above the knee joint.

- Subject will be blind folded to reduce visual cues and made to stand against the wall support.
- The subject will be explained about the motion of the knee joint and 3 trails of the same will be performed before starting the procedure.

Knee flexion:

- From the starting position at 0 degree of knee extension, the subject will be asked to squat to 30 degree of knee flexion and maintain the position for 15 seconds

Assessment of fatigue is done by Rate of Perceived Exertion (RPE)

- The assessment of the fatigue will be evaluated by measuring the intensity of exercises on RPE scale. The scale explains about the activities by their level of difficulty on a likert scale of 0-10. For example, 0 means no exertion performing an activity and 10 indicates a high level of difficulty in performing the activities. The scale is explained to the patient to ensure the exact understanding, so that it can be used correctly to reduce unwanted errors

Static balance by stork test

- A stork test will be used for the assessment of static balance. The subjects will perform the test without wearing shoes. They will be asked to stand on one leg with heel lift from the floor, both hands will be placed on his waist and lifting the other leg at the level of the knee. They will be asked to maintain the tiptoe position as long as they can. The time will be recorded by using a stopwatch till either the heel of the stance leg comes in contact with the floor or the other limb touches the ground or loses its balance in any direction. The stopwatch will be started when the heel is removed from the floor. They will be instructed not to lower their hands and not to turn their support leg in any direction or to bounce. The test will be performed first with the dominant leg then followed by the other leg. Practice trials will be given before measuring the actual recording trial, and three experimental trials will be given to the subject and the best-recorded value will be used for analysis (Reiman & Manske, 2000)

Power will be measured by vertical high jump

- Before starting the Vertical jump test, the subjects will be engaged in 8-10 minutes dynamic warms up, which includes squats, lunges, quadriceps stretch along with progressive jogging from 20-40 yards. The subject will be asked to stand by a wall keeping both feet's together, marking his/her finger with the chalk and make a jump as high as possible and marking the wall during the jump as M1. The subject will be instructed to make a similar second jump and mark the wall M2. The difference between M1 and M2 will be calculated. Out of the three jumps, the best jump will be considered to evaluate the subject's performance.

- The subjects will be informed about the purposes of this investigation and about procedures to which they would be submitted and made to sign a consent form.

- All subjects will be informed about the discomforts viz. fatigue, muscle soreness before signing the consent form. This study will be submitted for ethical approval from Institutional Ethical Committee.

- Muscle fatigue is a common complaint in recreational athletes. Any discomfort relating to the study and encountered during the study would be dealt with immediately.

- Proper screening evaluation will be done prior to the experimental test, so that the necessary precaution will be taken during the assessment.

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by Pooja Sharma

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SHORT SYNOPSIS

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Under the supervision of

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ABSTRACT:

Background/Introduction: Central fatigue is often believed as a physiological event that plays an applicable role in muscle fatigue, helps in protecting muscles against imprudent effort. Various authors have given different definitions for fatigue. Fatigue is an exercise-induced decrease in maximal voluntary force or power produced by a muscle or muscle group. There is a decrease in performance of the central nervous system, in which training and mental tiredness is encountered.

Objectives: This study aims to measure the effect of circuit training on central fatigue, physical performance and cognitive function in different level of recreational athletes.

Methodology: It will be an experimental Study design (pretest-posttest) with three experimental groups. Total of 63 subjects will be selected as per inclusion and exclusion criteria and categorized into one of three groups (n=21) on the basis of Global Physical Activity Questionnaire i.e low, moderate and severe physically active recreational athlete. They will be given six weeks (3 days per week) of high intensity circuit training. Circuit training session will be comprised of warm up followed by six stations of circuit training and cool down. Pre test and post test outcome measures will be taken before and after the six weeks of circuit training respectively.

Expected outcome: We expect the circuit training to be an effective training for low physically active recreational athlete in reducing central fatigue, enhancing physical performance and cognitive function when compared with moderate or severe physically active recreational athlete.

Key words: Central Fatigue, Circuit Training, Muscular fitness, Balance, Proprioception

INTRODUCTION

EFFECT OF CIRCUIT TRAINING ON CENTRAL FATIGUE, PHYSICAL PERFORMANCE AND COGNITIVE FUNCTION AMONG DIFFERENT LEVEL OF RECREATIONAL ATHLETES

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